U.S. Pat. Nos.: 4,514,527; 4,521,550; 4,588,756; 4,659,751; 5,270,351; 5,498,643; 5,690,840; and 5,756,560. N-phenylglycine (NPG) is an example of an initiator which acts both as a primer, initiator and a co-initiator for promoting the polymerization of adhesive polymeric resins and adhesive monomers onto the subject dental structure undergoing restoration. CQ is an example of a photoinitiator and/or photosensitizer. Both NPG and CQ may be used in conjunction with the present invention, either singly or in combination.

Application

The etchant/primer composition in accordance with the present invention is applied to a dental structure requiring restoration for a time sufficient to etch and prime the underlying dental structure. Thereafter, optionally, the applied etchant/primer composition may be rinsed, dried or both. Then, adhesive resin(s) or adhesive monomer(s) is/are applied thereto. Typically, the adhesive resin or the adhesive monomer(s) contain an initiator. Either immediately before or immediately after application of the adhesive resin or adhesive monomer to the dental structure, curing is initiated to form a polymeric structure on the subject dental structure. Additionally, the adhesive resin or polymerized monomer is modified to the desired shape and hardness.

The etchant/primer composition may be applied as further described below. The etchant/primer is applied to the tooth surface involved in the cavity preparation (e.g., enamel and/or dentin) with an applicator brush, microtip applicator, Quick-tip™, or cotton pellet and left standing for about 60 seconds. Thereafter, any excess etchant/primer is removed, preferably with a gentle stream of air. By similar application methods (e.g., applicator brush, microtip applicator, Quick-tip™, cotton pellets or the like), the adhesive resin is applied to the relevant dental structure (e.g., to the dental structure previously coated with the etchant/primer) in a single coat or multiple coats. Then, the so-applied adhesive resin is light cured or chemically cured to polymerize the resin. Finally, an appropriate composite is placed on the partially polymerized adhesive resin and shaped with various instruments (e.g., hand instruments, rotary instuments) to the desired conformation and then polymerized by chemical polymerization or cured by light e.g. visible light.

The etchant/primer/adhesive monomer composition of the present invention is applied to a subject dental structure for a time sufficient to form the desired dental restorative structure thereon. Typically, the etchant/primer/adhesive monomer composition is provided with an initiator which may be pre-mixed therewith immediately prior to application on the dental structure or so-provided already mixed in the etchant/primer/adhesive monomer composition. Either immediately before or immediately after application of this composition to the appropriate dental structure, curing is initiated to form the desired polymeric structure. During dental restoration, the adhesive resin or polymerized monomer is modified to the desired shape and hardness.

The etchant/primer/adhesive monomer composition may be applied as further described below. The etchant/primer is applied to the tooth surface involved in the cavity preparation (e.g., enamel and/or dentin) with an applicator brush, microtip applicator, Quick-tip™, or cotton pellet and left standing for about 60 seconds. Thereafter, any excess etchant/primer is removed, preferably with a gentle stream of air. By similar application methods (e.g., applicator brush, microtip applicator, Quick-tip™, cotton pellets or the like), the adhesive resin is applied to the relevant dental structure (e.g., to the dental structure previously coated with the etchant/primer) in a single coat or multiple coats. Then, the so-applied adhesive resin is light cured or chemically cured to polymerize the resin. Finally, an appropriate composite is placed on the polymerized adhesive resin and shaped with various instruments (e.g., hand instruments, rotary instuments) to the desired conformation and then polymerized by chemical polymerization or cured by light e.g. visible light.

Kit

A kit comprising an etchant/primer composition, a polar solvent system, an adhesive monomer, and an acid may be provided as noted below. The kit comprises:

(a) at least a first container containing an etchant/primer composition, said etchant/primer composition comprising:

(i) a compound having the formula:

$$RN(CH_2YCO_2M)_2$$

wherein $R=R^1$ or R^2;

R^1=an aromatic group;

R^2=a conjugated unsaturated aliphatic group;

Y=a single bond, CH_2, $CHCH_3$ or $C{=}CH_2$; and

each M is independently H, an alkali metal, an alkaline earth metal, aluminum, a transition or redox metal or an alkyl group having 1 to 18 carbon atoms, with the proviso that when both M groups are alkyl groups, said compound is capable of being easily hydrolyzed, displaced, or exchanged with other reagents present in the etchant/primer composition; and

(ii) a polar solvent system; and

(b) at least a second container containing an adhesive monomer system, wherein at least one of said first and second containers includes an acid.

The term "at least a first container" is intended to mean that the "etchant/primer composition" may be provided in a single "first" container or components of the "etchant/primer composition" may be split up among a plurality of "first" containers. However, it is preferable to provide the "etchant/primer composition" in a single "first" container. Likewise, the term "at least a second container" is intended to mean that the "adhesive monomer system" may be provided in a single "second" container or components of the "adhesive monomer system" may be split up among a plurality of "second" containers. Preferably, the "adhesive monomer system" is provided in a single "second" container. The term "adhesive monomer system" is intended to mean at least one adhesive monomer and at least one initiator. The contents of the "first" and "second" containers of the above-identified kit are combined either prior to application or during application thereof to the dental structure being restored.

The polar solvent system in the kit comprises solvents previously described. Such solvents include, but are not limited to, water, acetone, methyl ethyl ketone, propanol, ethanol, dimethylformamide, dimethylacetamide, dimethylsulfoxide, 1-methyl-2-pyrrolidinone or combinations and mixtures thereof.

Preferably, the acid in the kit is nitric acid. The nitric acid in the kit is provided to yield an amount of the acid, preferably, from about 0.05% to about 5.0% by weight, and more preferably, from about 0.1% to about 2.5% by weight, based on a total weight of the contents of the first and second containers.

The following examples are provided to illustrate various embodiments of the present invention. These examples are not intended to limit the scope of the appended claims.

EXAMPLES

Unless indicated otherwise, all percentages are percentages by weight based on a total weight of the composition